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ASIA PACIFIC

Queensland research base to study impact of microplastics on human health

2022-03-12

Researchers at the University of Queensland have been given a boost in their quest to find out exactly how harmful microplastics are to humans with the launch of a new specialist laboratory.

The Minderoo Centre – Plastics and Human Health will provide funding and equipment to researchers who are looking into the effect of nanoplastics on the human body.

Environmental health expert at UQ Kevin Thomas said having the resources to accurately measure nanoparticles of plastic meant they could answer some longstanding questions about their effect on the body.

"Plastic is in the environment, and it's a very complicated situation because there are many different types of plastics, and it's further changed in the environment through weathering," he said.

"It's a unique challenge because there is a complexity there we don't quite understand, but there is already a lot of data to suggest humans are exposed to a lot of plastic particles, so we are trying to quantify what is the effect of that exposure."

Microplastics have become increasingly ubiquitous in the environment over the last few decades, as they come from a range of sources, from plastic products like bottles to fragments of car tyres flaking off on roads.

And the problem is cumulative because the plastics continue to break down into smaller and smaller particles once they are in the environment.

Read More

Brisbane Times, 12-03-22

https://www.brisbanetimes.com.au/national/queensland/qld-research-base-to-determine-harm-of-microplastics-to-human-health-20220311-p5a3z3.html

Download full list of chemicals on the Inventory

2022-03-10

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We listened to your feedback about wanting to view a complete list of chemicals on the Inventory. For the first time, we've made this available in an Excel format (.xlsx).

We took a snapshot of all the chemicals on the Inventory on 10 February 2022 and published this as a downloadable spreadsheet.

Please note that the spreadsheet is not current and is not the official complete Inventory. It also does not contain links to assessments or evaluations and excludes confidentially listed chemicals.

The next version of the downloadable Inventory is expected to be available in late 2022.

Go to our chemical search page to download the Inventory spreadsheet

Australian Industrial Chemicals Introduction Scheme, 10-03-22

https://www.industrialchemicals.gov.au/news-and-notices/download-full-list-chemicals-inventory

AMERICA

EPA Proposes to Consolidate TSCA Section 8 ICRs

2022-03-14

The U.S. Environmental Protection Agency (EPA) announced on March 8, 2022, that it is planning to consolidate several Information Collection Requests (ICR) covering reporting and recordkeeping activities under Section 8 of the Toxic Substances Control Act (TSCA). 87 Fed. Reg. 12954. Before submitting the consolidated ICR to the Office of Management and Budget (OMB) for review and approval, EPA is soliciting comments on specific aspects of the proposed information collection. The consolidated ICR is entitled "Reporting and Recordkeeping Under Section 8 of the Toxic Substances Control Act (TSCA)" and is identified under EPA ICR No. 2703.01 and OMB Control No. 2070-[NEW]. According to EPA, it intends to streamline the presentation of the paperwork burden estimates for these various activities and eliminate any duplication, which in turn is expected to reduce the administrative burden for both the public reviewers and EPA. EPA's Supporting Statement summarizes the currently approved ICRs that would be consolidated in the new ICR:

- TSCA Section 8(a) Preliminary Assessment Information Rule (PAIR): Under TSCA Section 8(a), persons who manufacture or import chemical

substances listed at 40 C.F.R. Section 712.30 are subject to the Section 8(a) PAIR requirements. These manufacturers and importers must submit information about production, use, and/or exposure-related data. Certain specific chemical testing and reporting requirements under 40 C.F.R. Part 766 Subpart B that are very similar to the PAIR requirements are also covered within this information collection activity.

- Chemical-Specific Rules, TSCA Section 8(a): Under TSCA Section 8(a), persons who manufacture, import, or process certain chemical substances or mixtures, or propose to manufacture, import, or process certain chemical substances or mixtures, are subject to chemical-specific rules promulgated under TSCA Section 8(a). A chemical-specific Section 8(a) rule requires more detailed and more types of information than is required by a PAIR rule. Any chemical covered by TSCA for which the Office of Pollution Prevention and Toxics (OPPT), other EPA offices, or another federal agency has a reasonable need for information, and that cannot be satisfied via readily available sources or by use of other rulemakings, is a proper potential subject for a chemical-specific TSCA Section 8(a) rulemaking.
- Recordkeeping and Reporting Requirements for Allegations of Significant Adverse Reactions to Human Health or the Environment: Under TSCA Section 8(c), persons who manufacture, import, process, or distribute in commerce any chemical substance or mixture must keep records of significant adverse reactions to health or the environment, as determined by the Administrator by rule, alleged to have been caused by the substance or mixture. TSCA Section 8(c) requires that allegations of adverse reactions to the health of employees be kept for 30 years, and all other allegations be kept for five years. The rule also prescribes the conditions under which a firm must submit or make the records available to a duly designated representative of the Administrator.
- Health and Safety Data Reporting, Submission of Lists and Copies of Health and Safety Studies: Under TSCA Section 8(d), certain persons, who manufacture, import, process, or distribute in commerce (or propose to manufacture, import, process, or distribute in commerce) chemical substances and mixtures, are required to submit to EPA lists and copies of health and safety studies in their possession that relate health and/or environmental effects of the chemical substances and mixtures.
- Read More

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TSCA Blog, 14-03-22

https://www.tscablog.com/entry/epa-proposes-to-consolidate-tsca-section-8-icrs

EPA plan would limit downwind pollution from power plants

2022-03-12

The Environmental Protection Agency is proposing a plan that would restrict smokestack emissions from power plants and other industrial sources that burden downwind areas with smog-causing pollution they can't control.

The federal plan announced Friday is intended to help more than two dozen states meet "good neighbor" obligations under the Clean Air Act. States that contribute to ground-level ozone, or smog, are required to submit plans ensuring that coal-fired power plants and other industrial sites don't add significantly to air pollution in other states. In cases where a state has not submitted a "good neighbor" plan — or where EPA disapproves a state plan — the federal plan would take effect to ensure downwind states are protected.

"Air pollution doesn't stop at the state line," EPA Administrator Michael Regan said in a statement. The new federal plan "will help our state partners meet air quality health standards, saving lives and improving public health in smog-affected communities across the United States."

Read More

AP News, 12-03-22

https://apnews.com/article/business-environment-environment-air-pollution-pollution-b319d86b609aa149f58d4895be406bb2

Arizona utilities seek state, not federal, regulation of ash

2022-03-12

Arizona lawmakers are advancing legislation backed by utilities to have state regulators, not their federal counterparts, regulate disposal of toxic ash produced by coal-fired power plants.

The bill would shift the regulatory duty from the U.S. Environmental Protection Agency to the Arizona Department of Environmental Quality, the Arizona Republic reported.

A bill narrowly approved by the state House last month was endorsed Wednesday by a Senate committee, with one Democrat joining Republicans for the bill as other Democrats voted against it. If the bill remains unchanged, passage by the full Senate would send it to Republican Gov. Doug Ducey.

Supporters of the bill, including the Department of Environmental Quality itself, say the agency has the expertise and is familiar with the utilities involved, which include Arizona Public Service Co., Tucson Electric Power Co. and the Salt River Project.

Opponents have questioned whether the DEQ should take on the added responsibility, suggesting it might weaken enforcement. They cited close ties between the utilities and the DEQ and problems that the agency has had in monitoring water quality.

Read More

The Buffalo News, 12-03-22

https://buffalonews.com/news/national/govt-and-politics/arizona-utilities-seek-state-not-federal-regulation-of-ash/article_5b2d2d9d-74fc-52ea-a7c4-f0fa8b41a733.html

Impacts of 'forever chemicals' on real estate transactions

2022-03-12

There has been much coverage of PFAS, the "forever chemicals," in the past year. These emerging contaminants have spiked concern because of their pervasiveness in the environment and our relatively limited understanding of their impacts on human health. And while it seems there are more questions than answers surrounding PFAS as of now, the growing awareness of their detrimental impact could lead to increased environmental regulations and future liabilities for the real estate industry as these forever chemicals seem to live on in building materials and ground substances.

Therefore, it's important for those acquiring or building real estate to understand PFAS, the changing regulatory landscape surrounding them

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and what proactive measures can be taken to minimize future potential regulatory burdens or litigation risks.

Per- and polyfluoroalkyl substances (PFAS or PFOAS) are a family of more than 7,000 synthetic chemical compounds that have been in use since the 1930s and whose application has significantly expanded over the past century. PFAS are highly effective surfactants, lowering the surface tension between two liquids or between a liquid and a solid. They are also extremely resistant to heat.

Read More

Reuters, 12-03-22

https://www.reuters.com/legal/legalindustry/impacts-forever-chemicals-real-estate-transactions-2022-03-11/

EPA's Proposed Fenceline Screening Level Approach Needs Major Revisions if it is to Meet TSCA's Scientific Standards

2022-03-14

Recently the Environmental Protection Agency (EPA) rolled out a proposed screening level methodology to evaluate chemical exposures and risks to fenceline communities. There are serious flaws in the Agency's proposed approach and significant changes must be made to the proposal if EPA is to meet the scientific requirements mandated by TSCA.

In formal comments we recently submitted to EPA we have outlined several problems with its proposed fenceline screening level approach. In addition, this week we're providing oral comments to the Agency's TSCA Science Advisory Committee on Chemicals, which has importantly been asked conduct peer-review of the proposal.

A few highlights of ACC's concerns and our suggested remedies include:

Just as EPA's Exposure Assessment Guidelines recommend completing exposure assessments iteratively using a tiered approach, so should its proposed screening level approach. An explicit tiered approach would provide much-needed efficiencies to the process and transparency to stakeholders regarding EPA's decision-making process.

The approach as proposed fails to consider significant fenceline exposure assessment activity and expertise already existing in other EPA offices and state regulatory agencies. The Agency must look to, and where

appropriate, should rely on these as opposed to duplicating efforts and potentially wasting time and resources.

The proposed approach's reliance on Toxics Release Inventory (TRI) data is concerning. If EPA insists on incorporating TRI data into its fenceline screening level approach, those data need to be subject to a data quality assessment so that the variability and uncertainties associated with them are well understood, documented, and accounted for. TRI data in particular, while valuable for some purposes, are not sufficiently reliable to serve as the basis for a determination of unreasonable risk under TSCA.

Read More

American Chemistry Council, 14-03-22

https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2022/epa-s-proposed-fenceline-screening-level-approach-needs-major-revisions-if-it-is-to-meet-tsca-s-scientific-standards

EUROPE

Call to revise EU legislation for Waste Electrical and Electronic Equipment (WEEE)

2022-03-11

Production, use, and disposal of Electrical and Electronic Equipment (EEE) have severe environmental impacts. The increasing demand for such devices exhausts valuable resources, causes high energy demand, and frequently leads to the release of harmful substances into the environment. 2019 data clearly show that almost all member states fail to collect sufficient WEEE separately and therefore do not reach the EU target of 65 percent collection. As a consequence, up to 4.8 million tonnes of WEEE are still disposed improperly every year (e.g. in nature, residual waste streams, or illegal exports) and lost for re-use and recycling. The existing Directive 2012/19/EU (WEEE2 directive) entered into force in August 2012 and went only through minor revisions since then. Contrary to most EU laws, there was no clear revision clause and date in the 2012 text. In fact, some important regulations (e.g. treatment requirements) still trace back to the first WEEE Directive from 2002. Since there is the need for particular urgent action to reduce environmental impacts from WEEE, 4 environmental NGOs and representatives of waste treatment operators call on the EU Commission for a quick and fundamental recast of WEEE legislation. The upcoming European initiative setting new

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design requirements and consumer rights for electronics should clearly call for the WEEE Directive review to be started no later than 2023. It is, furthermore, recommended to consider a replacement of the WEEE2 directive with a WEEE Regulation, since a regulation comes into force immediately and is more legally binding

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EEB, 11-03-22

https://eeb.org/wp-content/uploads/2022/03/20220311_WEEE-Directive-review_background-paper_DUH-ECOS-EEB-RREUSE.pdf

Belgium finalizes stricter PFAS regulations, keeping 3M plant partially idle

2022-03-16

Belgian authorities have finalized stricter PFAS pollution standards, keeping a 3M plant near Antwerp partially idled.

Regulators cracked down on the "forever chemicals" last fall after testing showed elevated levels of PFAS in local residents' blood.

The government further tightened the emission standards in a decision released last week.

"For companies like 3M, I expect them to fully invest in limiting the present concentrations of hazardous substances to the strict minimum," Flemish Environment Minister Zuhal Demir said in a statement to Belgian media. "There will be close monitoring to ensure that these discharge standards are respected and action will be taken in the event of violations."

3M said it supports the reduced discharge limits but takes issue with restrictions on remediation technology and timeframes, according to a news release.

PFAS — short for perfluoroalkyl and polyfluoroalkyl substances — are a family of chemicals with nonstick and water-resistant properties used to make a range of products. They do not break down in the environment and have been linked to health problems and groundwater pollution in Washington County and elsewhere.

The plant in Zwijndrecht, Belgium, is one of five PFAS manufacturing sites Maplewood-based 3M has around the world. The others are in Alabama, Illinois, Germany and Cottage Grove.

Read More

Star Tribune, 16-03-22

https://www.startribune.com/belgium-finalizes-stricter-pfas-regulations-keeping-3m-plant-partially-idle/600156593/

INTERNATIONAL

680+ Investors Call on Over 10K Companies to Share Environmental Data

2022-03-15

While more companies are reporting through CDP every year, many still do not disclose enough data on their environmental impact. Non-disclosure will not be an option for many companies for much longer, with a series of mandatory environmental disclosure requirements coming this year around the world.

More than 680 financial institutions worth over US$130 trillion in assets are calling on the Boards of nearly 10,400 companies worldwide — worth US$105 trillion in market cap — to disclose data on their environmental impact this year through CDP.

The groups of investors — which includes Allianz, Amundi, AXA, BNP Paribas, CalPERS, Capital Group, State Street and Vanguard — sent letters today requesting the companies in question disclose their data on all or some of the following environmental issues: climate change, deforestation and water security.

Almost 100 more financial institutions — including asset managers, asset owners, banks and insurance companies — have put their name to the disclosure request this year compared to last, demonstrating rising demand for TCFD-aligned corporate environmental information.

This growing market demand is driving more transparency every year, with CDP last year recording higher corporate disclosure numbers than ever before. Nearly 3,200 companies (out of 7,176 requested) disclosed their environmental information in response to CDP's Letter to the Board in 2021. This is in addition to over 10,100 other companies that disclosed through CDP, either at the request of their business customers through CDP's Supply Chain program, or of their own volition. So, over 13,000 companies, total — representing some 64 percent of global market cap — disclosed their data through CDP in 2021.

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Companies being asked to disclose by these institutions include over 3,300 companies that are being requested for the first time (marking a 46 percent increase since last year), as CDP pushes to scale the uptake of corporate environmental reporting even further. Since the first disclosure request was sent out in 2002, CDP has grown to house the world's largest global repository of environmental data; but by 2025, the aim is to grow this to cover 90 percent of the world's highest-impact firms.

Read More

Sustainable Brands, 15-03-22

https://sustainablebrands.com/read/finance-investment/680-investors-call-on-over-10k-companies-to-share-environmental-data/

REACH Update

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Commission invites interested parties to share views on the Revision of the Detergents Regulation

2022-03-02

Today, the Commission published a public consultation on the Revision of the Detergents Regulation.

The Commission seeks the views and experiences of all relevant parties on how to improve the current legislation in order to achieve clear, simplified and updated rules that allow for innovative products and sustainable new practices; burden reduction for manufacturers and clearer information to consumers; and an optimised protection of human health and the environment.

The consultation follows the latest Evaluation of the Detergents Regulation and the Fitness Check of the most relevant chemicals legislation (excluding REACH) which revealed a number of weaknesses and areas for further improvement. These include overlaps with other pieces of EU chemicals legislation such as the Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and the Regulation on classification, labelling and packaging of substances and mixtures. It points out unclear information to consumers, an increasingly complex regulatory framework for detergents and the need to update the legislation to adapt it to recent market developments and consumer practices. The Detergents Regulation lays down specific rules for placing detergents on the EU market.

The Revision of the Directive contributes to the EU Green Deal and its chemicals strategy for sustainability that aims to better protect the public and the environment against hazardous chemicals and encourage innovation in developing safe and sustainable alternatives. It also contributes to the EU Industrial Strategy and its 2021 Update by assessing the need to introduce digital labelling for detergents as a means of providing clearer information to consumers. The public consultation will be open until 25 May 2022.

Read More

European Commission, 2-03-22

https://ec.europa.eu/growth/news/commission-invites-interested-parties-share-views-revision-detergents-regulation-2022-03-02_en

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Janet's Corner

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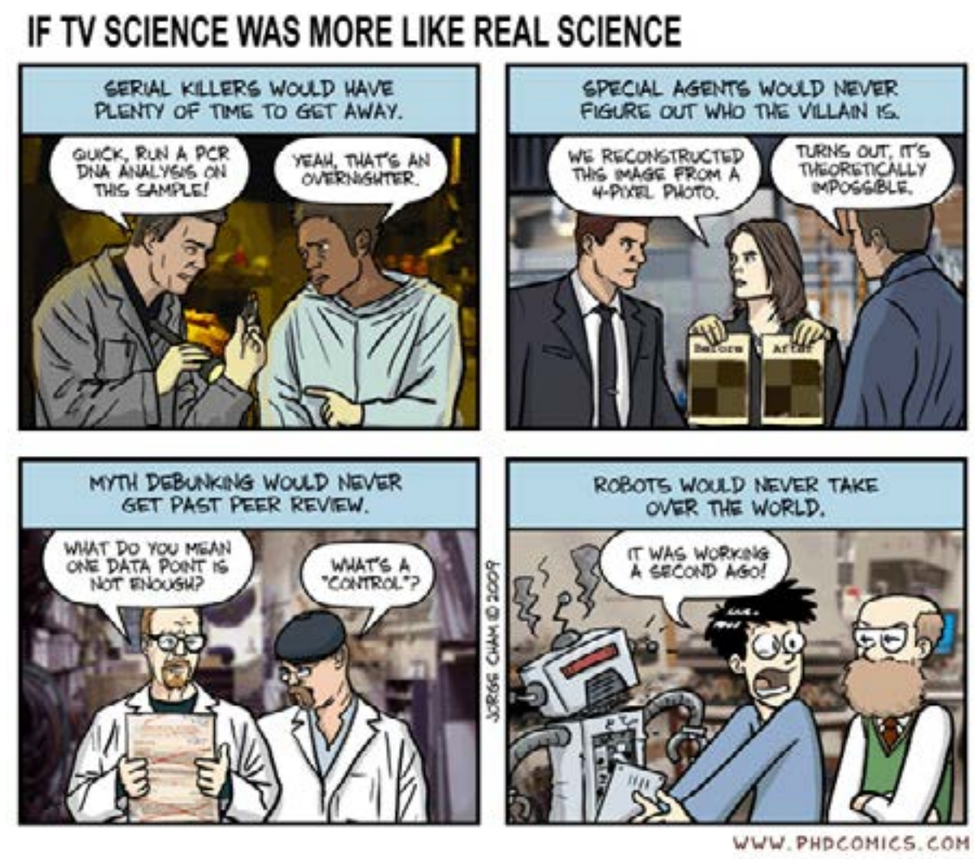
If TV science was more like real science

2022-03-25



https://phdcomics.com/comics/archive.php?comicid=1156

Titanium Tetrachloride

2022-03-25

Titanium tetrachloride is the inorganic compound with the formula $TiCl_4$. [1] It is a colourless to pale yellow liquid that has fumes with a strong odour. If it comes in contact with water, it rapidly forms hydrochloric acid, as well as titanium compounds. Titanium tetrachloride is not found naturally in the environment and is made from minerals that contain titanium. [2]

USES [3]

Titanium tetrachloride is used as an intermediate in the production of titanium metal, titanium dioxide, and titanium pigments. It is also used in the manufacture of iridescent glass and artificial pearls, as a polymerisation catalyst, and to produce smoke screens. Titanium tetrachloride was formerly used with potassium bitartrate as mordant in the textile industry and with dyewoods in dyeing leather.

IN THE ENVIRONMENT [2]

Titanium tetrachloride enters the environment primarily as air emissions from facilities that make or use it in various chemical processes or as a result of spills. If moisture is present in the air, titanium tetrachloride reacts with the moisture to form hydrochloric acid and other titanium compounds, such as titanium hydroxide and titanium oxychlorides. The end-products produced when titanium tetrachloride reacts with water are titanium dioxide and hydrochloric acid. The hydrochloric acid may break down or be carried in the air. Some of the titanium compounds may settle out to soil or water. In water, they sink into the bottom sediments. They may remain for a long time in the soil or sediments. Some other titanium compounds, such as titanium dioxide, are also found in the air and water.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

- It is unlikely that you will be exposed to titanium tetrachloride in water, soil, food, or air.
- As titanium tetrachloride breaks down rapidly in air, you probably would not be exposed to it unless you worked in an industry that made or used it.

Titanium tetrachloride is the inorganic compound with the formula TiCl4.

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- If you work in an industry that uses titanium tetrachloride, you could be exposed by breathing it or touching it.
- If titanium tetrachloride spills, you could get it on your skin.

Routes of Exposure [5]

Probable routes of human exposure to titanium tetrachloride are inhalation, ingestion, and dermal contact.

HEALTH EFFECTS [3]

Acute Effects

- Titanium tetrachloride is highly irritating to the skin, eyes, mucous membranes, and respiratory tract in humans. Acute exposure may result in surface skin burns, marked congestion of mucous membranes of the pharynx, vocal cords, and trachea, and stenosis (constriction) of the larynx, trachea, and upper bronchi in humans. Acute exposure may also damage the cornea.
- A worker accidentally exposed to a high concentration of titanium tetrachloride via inhalation later developed endobronchial polyps.
- Eye injury, including corneal opacity, necrotic keratitis, and conjunctivitis, occurred in rats acutely exposed to titanium tetrachloride vapours.
- Acute animal tests in rats and mice have demonstrated titanium tetrachloride to have high to extreme acute toxicity via inhalation.

Chronic Effects

- Pleural thickening and decreased pulmonary function have been associated with chronic occupational exposure of titanium tetrachloride in titanium metal production workers.
- Chronic inhalation exposure may result in upper respiratory tract irritation, chronic bronchitis, cough, bronchoconstriction, wheezing, chemical pneumonitis, or pulmonary oedema in humans.
- Respiratory effects have also been observed in animals chronically exposed to titanium tetrachloride via inhalation.
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for titanium tetrachloride.
- ATSDR has calculated a chronic inhalation minimal risk level (MRL) of 0.0001 milligrams per cubic metre (mg/m^3) based on respiratory effects in rats. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of

adverse noncancer health effects over a specified duration of exposure. Exposure to a level above the MRL does not mean that adverse health effects will occur. The MRL is intended to serve as a screening tool.

Reproductive/Developmental Effects

- No information is available on the reproductive or developmental effects of titanium tetrachloride in humans or animals.

Cancer Risk

- No association between titanium tetrachloride exposure and lung cancer mortality was found in one study of occupationally exposed workers.
- No carcinogenic were observed in rats chronically exposed to titanium tetrachloride via inhalation.
- EPA has not classified titanium tetrachloride with respect to carcinogenicity.

SAFETY [6]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.
- Skin Contact: If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands: Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation.

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- WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls and Personal Protection

Engineering Controls

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling titanium tetrachloride:

- Face shield;
- Full suit;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves;
- Boots.

Personal Protective Equipment in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States [2]

- Releases of more than 1 pound of titanium tetrachloride must be reported to the Environmental Protection Agency.
- Maximum levels have not been established for titanium tetrachloride exposure in the workplace.

REFERENCES

1. http://en.wikipedia.org/wiki/Titanium_tetrachloride
2. http://www.atsdr.cdc.gov/phs/phs.asp?id=662&tid=122
3. http://www.epa.gov/ttn/atw/hlthef/titanium.html
4. http://www.atsdr.cdc.gov/toxfaqs/tfacts101.pdf
5. http://scorecard.goodguide.com/chemical-profiles/html/titanium_tetrachloride.html
6. http://www.sciencelab.com/msds.php?msdsId=9925270

The Plastics Industry Says It Has a Clever Solution to the Plastics Crisis

2022-03

Every week, carefully sorted piles of plastic waste adorn curbsides across the country, waiting for pickup. It once went overseas, but now China and other former importers have banned or imposed prohibitive costs on shipments, having concluded there is little to do with the stuff. Cities have cut back collection schemes, leaving straws, bottles, utensils, and other detritus to pile up in warehouses or be disposed of as trash.

Those systems, in theory, created a destination for plastics aside from landfills, assuaging consumer guilt about using polluting—and practically indestructible—products. But as the bottom fell out of the international market, an inconvenient truth was highlighted: Most plastics are impervious to traditional recycling.

"What we built in terms of waste management systems—be it landfills, be it incinerators, be it curbside recycling systems—doesn't really work well for plastic. That's now come back to bite us."

"What we built in terms of waste management systems—be it landfills, be it incinerators, be it curbside recycling systems—doesn't really work well for plastic. That's now come back to bite us."

In response to the crisis, the plastics industry is pushing investments in so-called chemical recycling, hoping to give plastics a new, guilt-free life cycle. To understand what this means, let's look at how plastics are made. The material is formed when many small hydrocarbon molecules from oil, called monomers, bond to create long chains, like dancers joining hands in a chorus line—a process called polymerization. The nature of the monomers and the configuration of the chemical bonds determine the kind of plastic (or polymer) produced, just as dancers' costumes and positions define their look onstage.

Traditional recycling does not break apart the polymer molecules. Instead, it simply heats the plastic until it melts, reshaping the liquid into a different object. But the process inevitably degrades the polymer chains, resulting in inferior recycled products. Plastic bottles might get downcycled into textile padding that, in turn, has no further destination other than a landfill. Of the billions of tons of plastic ever made, Geyer and two colleagues estimated in 2017 that only about 9 percent has been recycled. The rest has been incinerated or, more often, just dumped—at best into landfills, at worst into trash piles that can leak into rivers and streams.

In contrast, in its ideal form, chemical recycling depolymerizes those chains—like making the dancers release each other's hands—to reassemble them as useful chemical compounds or pristine, good-as-new

polymers. The Plastics Industry Association has hailed the technology as "essential to ensuring that plastics stay out of the environment, while also creating new products and economic growth opportunities that benefit society."

At least, that's the sales pitch. In reality, chemical recycling as it is performed today almost always refers to one of two very similar processes, pyrolysis or gasification, that rely on temperatures of over 1,600 degrees Fahrenheit to break plastics down into base components. The result is a mixture of hydrocarbons—some of which may be polymerized into more plastic. The rest are likely to be burned as fuel that is often more toxic than its virgin counterpart since it's laced with residual contaminants like flame retardants. As chemist Susannah Scott of UCSB says, "This is greenwashing; this is not true recycling."

Scott is one of a growing number of researchers exploring how to make chemical recycling more sustainable. Instead of ripping up polymer chains into heterogeneous fragments, a better process would perform microsurgery to dissect them into reusable molecules. In theory, we could accomplish this either by producing alternative polymers that can more easily be recycled chemically or by using waste polymers to make other, valuable chemicals—an approach known as upcycling.

In 2020, two prestigious international scientific journals explored each technique. In Nature, researchers unveiled two plastics similar to existing polyethylenes that are used in everything from reusable plastic cups to pipes. The new substances, when gently heated in ethanol for a few hours, dissolved into their monomer blocks—units that, in theory, could be infinitely reusable. Meanwhile, in Science, Scott and her team, whose research has been supported by both federal and petrochemical funding, described an upcycling process that transformed waste polyethylene into molecules commonly used as detergents but avoided the extreme heat, crude oil, and toxic chemicals that usually go into their production. The details still need to be ironed out, but she believes that if a reaction looked commercially promising, companies could quickly rework their processes.

Not everyone agrees. Many environmentalists argue that chemical recycling simply provides political cover for the continued production of plastics and the fossil fuels it takes to make them. Consumers shouldn't be fooled by a solution to plastics that, well, involves plastics. Andrew Rollinson, the author of a report for the Global Alliance for Incinerator Alternatives, has found that chemical recycling is energy-intensive and

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costly—so it irks him that both industry and government are investing heavily in the process instead of just reducing or eliminating plastics.

"Some really innovative, clever chemical engineers are coming up with some really promising technologies," concludes Roland Geyer, the industrial ecologist. "Do I think that will make the entire problem go away? Absolutely not."

Mother Jones, March-April 2022

https://motherjones.com

Laser flashes for cancer research: Research team achieves milestone in proton irradiation

2022-03-14

Irradiation with fast protons is a more effective and less invasive cancer treatment than X-rays. However, modern proton therapy requires large particle accelerators, which has experts investigating alternative accelerator concepts, such as laser systems to accelerate protons. Such systems are deployed in preclinical studies to pave the way for optimal radiation therapy. A research team led by the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) has now successfully tested irradiation with laser protons on animals for the first time, as the group reports in the journal Nature Physics.

Radiation therapy is one of the main cancer treatment methods. It usually leverages strong, focused X-ray light.

Radiation therapy is one of the main cancer treatment methods. It usually leverages strong, focused X-ray light. Protons—the nuclei of hydrogen atoms—accelerated to high energies and bundled into small, precisely targetable bunches are an alternative. They can penetrate deep into the tissue where they deposit most of their energy in the tumor, destroying the cancer while leaving the surrounding tissue largely intact. This makes the method both more effective and less invasive than X-ray therapy. "The method is particularly suitable for irradiating tumors at the base of the skull, in the brain, and in the central nervous system," explains HZDR researcher Dr. Elke Beyreuther. "It is also used in pediatric cancer patients to reduce possible long-term effects."

However, the method is significantly more complex than X-ray therapy as it requires elaborate accelerator facilities to generate the fast protons and transport them to the patient. This is why there are only a few proton therapy centers in Germany, including one at Dresden University Hospital. Currently, experts are working to steadily improve the method and adapt

it to patients. Laser-based proton accelerators could make a decisive contribution here.

Customized laser flashes

"The approach is based on a high-power laser to generate strong and extremely short light pulses, which are fired at a thin plastic or metal foil," explains HZDR physicist Dr. Florian Kroll. The intensity of these flashes knocks swaths of electrons out of the foil, creating a strong electric field that can bundle protons into pulses and accelerate them to high energies. Fascinatingly, the scale of this process is miniscule: The acceleration path is merely a few micrometers long.

"We have been working on the project for 15 years, but so far, the protons hadn't picked up enough energy for irradiation," Beyreuther reports. "Also, the pulse intensity was too variable, so we couldn't make sure we were delivering the right dose." But over the past few years, scientists finally achieved crucial improvements, in particular thanks to a better understanding of the interaction between the laser flashes and the foil. "Above all, the precise shape of the laser flashes is particularly important," Kroll explains. "We can now tailor them to create proton pulses that have sufficient energy and are also stable enough."

New research requirements

Finally, the parameters had been optimized to the point that the HZDR team was able to launch a crucial series of experiments: the first-ever, controlled irradiation of tumors in mice with laser-accelerated protons. The experiments were carried out in cooperation with experts from Dresden University Hospital at the OncoRay—National Center for Radiation Research in Oncology and benchmarked with comparative experiments at the conventional proton therapy facility. "We found that our laser-driven proton source can generate biologically valuable data," Kroll reports. "This sets the stage for further studies that will allow us to test and optimize our method."

Another special feature of laser-accelerated proton pulses is their enormous intensity. While in conventional proton therapy, the radiation dose is administered in a span of a few minutes, the laser-based process could occur within a millionth of a second. "There are indications that such a rapid dose administration helps spare the healthy surrounding tissue even better than before," explains Elke Beyreuther. "We want to follow up on these indications with our experimental setup and conduct preclinical

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studies to investigate when and how this rapid irradiation method should be used to gain an advantage in cancer therapy."

Phys Org, 14 March 2022

https://phys.org

A new model of pathogen transmission in developing urban landscapes

2022-03-14

Scientists from the International Livestock Research Institute (ILRI), the University of Liverpool, the University of Edinburgh and elsewhere have traced how diverse strains of a common pathogenic bacteria spread in Nairobi, Kenya, shedding light on how diseases might emerge and proliferate within a complex city—and how they might best be controlled. The study appears in the April edition of Nature Microbiology.

Urban settlements in low-income countries are sites of enormous economic energy and cultural dynamism but also potential havens for new and emerging diseases, particularly zoonoses and antimicrobial-resistant bacteria.

Urban settlements in low-income countries are sites of enormous economic energy and cultural dynamism but also potential havens for new and emerging diseases, particularly zoonoses and antimicrobial-resistant bacteria. In Nairobi, Kenya, some 60 per cent of the population live in crowded low-income settlements characterized by poor sanitation and home to a wide variety of livestock and urban, synanthropic animals (undomesticated animals that live in close proximity to and benefit from humans such as rodents and scavenging birds). Yet relatively little is known about how bacteria are shared among hosts and potential reservoirs, and how such hosts and reservoirs themselves create connectivity between different sections of the city.

"These settlements are mega concoctions of people and animals," said lead author Dr. Dishon M. Muloi, currently with ILRI and former Ph.D. student at the University of Edinburgh, "with a chance of a flow of bacteria from either direction, from animals to humans or from humans to animals."

In the most extensive epidemiological study of its kind, a team led by Professor Eric Fèvre of ILRI and the University of Liverpool sampled Escherichia coli from humans, livestock and peri-domestic wildlife in 99 households across Nairobi. "We wanted to understand the urban environment through the eyes of an organism that could move between hosts and potentially create a pathogenic problem," said Fèvre. "We know that urbanization is a risk multiplier for emerging diseases, but we need a better understanding of how the physical environment influences pathogen emergence and transmission."

E. coli was chosen as a proxy for bacteria in general because of its ubiquity and because the tools for understanding its genetics are already well developed.

The findings were sobering. The first is that the diversity of bacteria are extensive: If you find an organism in one location, you're likely to find it in a wide variety of locations, not only within Nairobi but globally. Secondly, the study found that pathogens are being shared by humans and between human and animal populations. "The same strain of E. coli that we find in a chicken might be found in a human," said Muloi.

This result is particularly concerning because of the widespread and somewhat indiscriminate use of antibiotics in both humans and livestock in many developing countries—raising the specter that antimicrobial-resistant bacteria may emerge in one organism and move to others.

In fact, since humans and livestock have similar genetic mechanisms for resistance, it may not be the bacteria itself that transmits but the resistance mechanism that is independent of the bacteria. Known as plasmids, these are independent bits of DNA that can move from one bacteria to another. "They have their own population biology that we are only beginning to understand," says Fèvre.

But perhaps the most intriguing finding is that households serve as the key gateway through which bacterial transmission occurs. "Those within a household, including humans and animals, share bacteria," explains Muloi. "But then from one household to another, there is something like a guard, a security person, who will ensure that you don't cross that particular barrier. So while sharing commonly occurs within the household, the household selects, by its own particular micro-biology, which bacteria to admit."

"To get in the door of the house might present some difficulties," says Fèvre. "But once it gets in, then it will infect everybody who's in there and so to speak lounge very comfortably on the living-room sofa."

The household transmission model offers some critical lessons for the study and surveillance of future pathogens. As Fevre explains: "We often discuss transmission using the analogy of a wave, but in fact it's a story of multiple short infections or transmission events that then lead to a multitude of infections within those micro populations. It's not moving as a wave, in other words, but it's moving through a much more structured series of events. So we now have a much better understanding of how cities both can be colonized by new infectious agents, and how those

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infectious agents spread through a complex city. And knowing that we can start to think about how to control those events and stop them from happening."

Ultimately, as Muloi explains, the lessons learned in the project have implications not just for the developing nations: "The E. coli in Nairobi represents the E. coli across the entire world. What is being seen in Nairobi today could easily be in New York or Paris by tomorrow morning."

The study is part of the multi-center "Epidemiology, ecology and socio-economics of disease emergence in Nairobi" project funded by the UK Research Council Environmental and Social Ecology of Human Infectious Diseases (ESEI) initiative.

Dr. Carolyn Johnson, a program manager at the Medical Research Council, says that "the Environmental and Social Ecology of Human Infectious Diseases initiative, which was established to respond to new and emerging pathogen threats, was developed to support novel approaches to study the ecology of infectious disease."

"This MRC funded project is an excellent example of a novel, interdisciplinary project, aiming to tackle the growing problem of E. Coli infection at the intersection between livestock and humans."

"The project involved both the national and international research community and has the potential to significantly aid our understanding of antimicrobial resistance."

Dr. Bryan Wee, Senior Research Fellow at The University of Edinburgh and co-lead author of the paper, says that "understanding more about transmission of microbes between livestock and humans is crucial to protecting health, globally. This paper is an excellent example of work co-led by The Universities of Edinburgh and Liverpool as part of a wide collaboration, working with the team in Nairobi to offer insights of global relevance. The rapid development of the city along with practice of keeping livestock within urban households has offered a powerful setting to develop our understanding of how antimicrobial resistance arises."

Phys Org, 14 March 2022

https://phys.org

Spider silk could stabilize cancer-suppressing protein

2022-03-14

The p53 protein protects our cells from cancer and is an interesting target for cancer treatments. The problem is, however, that it breaks down rapidly in the cell. Researchers at Karolinska Institutet in Sweden have now found an unusual way of stabilizing the protein and making it more potent. By adding a spider silk protein to p53, they show that it is possible to create a protein that is more stable and capable of killing cancer cells. The study is published in the journal Structure.

p53 plays a key role in the body's defense against cancer, in part by discovering and preventing genetic mutations that can lead to cancer. If a cell is lacking functional p53, it quickly becomes a cancer cell that starts to divide uncontrollably. Researchers around the world are therefore trying to develop cancer treatments that in some way target p53.

"The problem is that cells only make small amounts of p53 and then quickly break it down as it is a very large and disordered protein," says the study's last author Michael Landreh, researcher at the Department of Microbiology, Tumor and Cell Biology, Karolinska Institutet. "We've been inspired by how nature creates stable proteins and have used spider silk protein to stabilize p53. Spider silk consists of long chains of highly stable proteins, and is one of nature's strongest polymers."

P53 plays a key role in the body's defense against cancer, in part by discovering and preventing genetic mutations that can lead to cancer.

In a collaborative project with, amongst others, Jan Johansson and Anna Rising at KI's Department of Biosciences and Nutrition, who use spider silk in their research, the researchers attached a small section of a synthetic spider silk protein onto the human p53 protein. When they then introduced it into cells, they found that the cells started to produce it in large quantities. The new protein also proved to be more stable than ordinary p53 and capable of killing cancer cells. Using electron microscopy, computer simulations, and mass spectrometry, they were able to show that the likely reason for this was the way the spider silk part managed to give structure to p53's disordered sections.

The researchers now plan to study the protein's structure in detail and how its different parts interact to prevent cancer. They also hope to find out how the cells are affected by the new potent p53 protein and how well they tolerate its spider-silk component.

"Creating a more stable variant of p53 in cells is a promising approach to cancer therapy, and now we have a tool for this that's worth exploring," says co-author and senior professor Sir David Lane at Karolinska Institutet.

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"We eventually hope to develop an mRNA-based cancer vaccine, but before we do so we need to know how the protein is handled in the cells and if large amounts of it can be toxic."

Sir David Lane was one of the discoverers of the p53 protein in the late 1970s. p53 has been called the guardian of the genome because it can stop cells with DNA damage from turning into cancer cells. Mutations of the p53 gene are found in roughly half of all cancer tumors, which makes it the most common genetic change in cancer.

Phys Org, 14 March 2022

https://phys.org

Gravity can solve clean energy's biggest tech problem

2022-03-14

Renewables cannot provide consistent power without high-efficiency and high-availability storage. Unlike a fossil fuel power station, which can operate night and day, wind and solar power are intermittent. This means that if a cloud blocks the sun or there's a lull in the wind, electricity generation drops.

The advanced gravity energy storage solutions offered by Energy Vault address this problem through proven physics and engineering fundamentals of pumped hydroelectric energy storage. However, they replace water with custom-made composite blocks, known as "mobile masses", that do not lose capacity over time. By using proprietary technology, the system can automatically raise and lower the bricks, storing the potential energy in the elevation gain, and then generating and discharging electricity while the bricks are lowered.

In this system, excess energy is used to hoist 30 ton "mobile masses" into the air. When power is required, the mass descends which is similar to pumped hydroelectric storage.

In this system, excess energy is used to hoist 30 ton "mobile masses" into the air. When power is required, the mass descends which is similar to pumped hydroelectric storage.

The composite blocks can be made from low-cost and locally sourced materials, including the excavated soil at the construction site, but can also utilize waste materials such as mine tailings, coal combustion residuals (coal ash), and fiberglass from decommissioned wind turbine blades.

Additionally, the Energy Vault systems are intended to minimize environmental and supply chain risks. The systems are automated with advanced computer control and machine vision software that orchestrate

the charging and discharging cycles while meeting a broad set of storage durations starting from 2 hours and continuing to 12 hours, or more.

Crunching numbers

The company's vice president of sales Omar Aoun, speaking to Energy Voice in Abu Dhabi last month, said the technology had a round trip efficiency of around 80%.

"It's second best to batteries, which offer around 90% for four hours of storage. Alternative storage options are around 60% or less," he said. "It's very scalable. The way to think of it is that width is what drives the MW and the depth of the building is what drives the MWh."

To be cost effective, an Energy Vault project would need a minimum size of 25 MW with a duration of eight hours, he said. The company calculates that a two acre plot would provide 100 MW, with a height of 100 metres, so 1 GW would require 20 acres.

Energy Vault has a demonstration project in Switzerland in operation, which it connected to the grid in July 2020. This plant is helping the company tackle efficiency while also driving costs down. This original design was similar to a crane, while the newer design, EVx, is more like a building.

"At scale, this becomes more economical than batteries. The foundation is a big part of the cost," Aoun said. The company claims that its technology is 51% of the cost of lithium ion batteries.

"There's a mix of customers, from independent power producers [IPPs], large utilities and through to large mining companies." The company has signed a memorandum of understanding (MoU) with BHP.

Power from an energy storage project can go to a variety of uses, whether simply providing electricity, or green hydrogen or pricing arbitrage.

On track for Texas

"The first commercial project will start up by the end of next year and it will be in Texas," Aoun said. "Energy storage is a growing market and it will continue to grow. We're only scratching the surface at this point."

One area for growth will be in China. Atlas Renewable, backed by China Tianying, made a $50m investment in Energy Vault before the listing. It will pay another $50m to licence the energy storage technology this year.

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In building the mobile masses, Energy Vault has raised the prospect of using combustion residuals from coal power plants and repurposing materials from wind turbine blades. Enel Green Power has signed up to back the latter.

The Brighter Side of News, 14 March 2022

https://thebrighterside.news

First-of-its-kind research reveals rapid changes to the Arctic seafloor as submerged permafrost thaws

2022-03-14

A new study from MBARI researchers and their collaborators is the first to document how the thawing of permafrost, submerged underwater at the edge of the Arctic Ocean, is affecting the seafloor. The study was published in the Proceedings of the National Academy of Sciences on March 14, 2022.

Numerous peer-reviewed studies show that thawing permafrost creates unstable land which negatively impacts important Arctic infrastructure, such as roads, train tracks, buildings, and airports. This infrastructure is expensive to repair, and the impacts and costs are expected to continue increasing.

Using advanced underwater mapping technology, MBARI researchers and their collaborators revealed that dramatic changes are happening to the seafloor as a result of thawing permafrost. In some areas, deep sinkholes have formed, some larger than a city block of six-story buildings. In other areas, ice-filled hills called pingos have risen from the seafloor.

"We know that big changes are happening across the Arctic landscape, but this is the first time we've been able to deploy technology to see that changes are happening offshore too," said Charlie Paull, a geologist at MBARI and one of the lead authors of the study. "This groundbreaking research has revealed how the thawing of submarine permafrost can be detected, and then monitored once baselines are established."

While the degradation of terrestrial Arctic permafrost is attributed in part to increases in mean annual temperature from human-driven climate change, the changes the research team has documented on the seafloor associated with submarine permafrost derive from much older, slower climatic shifts related to our emergence from the last ice age. Similar

In some areas, deep sinkholes have formed, some larger than a city block of six-story buildings. In other areas, ice-filled hills called pingos have risen from the seafloor.

changes appear to have been happening along the seaward edge of the former permafrost for thousands of years.

"There isn't a lot of long-term data for the seafloor temperature in this region, but the data we do have aren't showing a warming trend. The changes to seafloor terrain are instead being driven by heat carried in slowly moving groundwater systems," explained Paull.

"This research was made possible through international collaboration over the past decade that has provided access to modern marine research platforms such as MBARI's autonomous robotic technology and icebreakers operated by the Canadian Coast Guard and the Korean Polar Research Institute," said Scott Dallimore, a research scientist with the Geological Survey of Canada, Natural Resources Canada, who led the study with Paull. "The Government of Canada and the Inuvialuit people who live on the coast of the Beaufort Sea highly value this research as the complex processes described have implications for the assessment of geohazards, creation of unique marine habitat, and our understanding of biogeochemical processes."

Background

The Canadian Beaufort Sea, a remote area of the Arctic, has only recently become accessible to scientists as climate change drives the retreat of sea ice.

Since 2003, MBARI has been part of an international collaboration to study the seafloor of the Canadian Beaufort Sea with the Geological Survey of Canada, the Department of Fisheries and Oceans Canada, and since 2013, with the Korean Polar Research Institute.

MBARI used autonomous underwater vehicles (AUVs) and ship-based sonar to map the bathymetry of the seafloor down to a resolution of a one-meter square grid, or roughly the size of a dinner table.

Paull and the team of researchers will return to the Arctic this summer aboard the R/V Araon, a Korean icebreaker. This trip with MBARI's long-time Canadian and Korean collaborators—along with the addition of the United States Naval Research Laboratory—will help refine our understanding of the decay of submarine permafrost.

Two of MBARI's AUVs will map the seafloor in remarkable detail and MBARI's MiniROV—a portable remotely operated vehicle—will enable further exploration and sampling to complement the mapping surveys.

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https://phys.org

Medicago's homegrown, plant-based COVID-19 vaccine approved by Health Canada

2022-02-24

Medicago's plant-based COVID-19 vaccine is now approved by Health Canada, which will soon give Canadians the option of getting a homegrown shot against SARS-CoV-2.

Regulators announced the decision to allow its use for adults 18 to 64 years of age on Thursday, making this the sixth vaccine approved in Canada, on the heels of Health Canada's approval of the Novavax shot last week.

In what the biopharmaceutical company calls a world first, the vaccine from Quebec City-based Medicago uses plant-derived, virus-like particles, which resemble the coronavirus behind COVID-19 but don't contain its genetic material.

The shots also contain an adjuvant from British-American vaccine giant GlaxoSmithKline to help boost the immune response.

In December, the companies reported high efficacy levels against infection as they geared up for regulatory approval.

High efficacy rate

Dubbed "Covifenz," the two-dose shot's overall efficacy rate against all virus variants studied was 71 per cent, with a higher efficacy rate of 75 per cent against COVID-19 infections of any severity from the delta variant, then dominant, according to data shared at the time in a press release.

The results followed a global, Phase 3, placebo-controlled study of the two-dose vaccine that was launched last March. This was before the highly contagious Omicron family of subvariants, including BA.1 and BA.2, began circulating, though the company has said the vaccine can be adapted as needed.

"While additional confirmatory data are needed, preliminary and exploratory data shows that Covifenz produces neutralizing antibodies against the Omicron variant," noted Health Canada in a statement.

A world first, the vaccine […] uses plant-derived, virus-like particles, which resemble the coronavirus behind COVID-19 but don't contain its genetic material.

The department has also placed terms and conditions on the authorization. Medicago must continue to provide information to Health Canada on the safety and efficacy of the vaccine, "including protection against current and emerging variants of concern as soon as it is available," the statement continued.

"We will, in the next several months, know how well our vaccine did against Omicron," the company's medical officer, Dr. Brian Ward, told CBC News, citing ongoing company trials, which also include a study on a booster dose that's slated to start within weeks.

Medicago 'manufacturing doses'

In October, Canada signed a deal to buy 20 million doses of Medicago's vaccine, with an option for 56 million more.

In a press release issued on Thursday, the company stressed a commitment to providing its shots as soon as possible.

"The approval of our COVID-19 vaccine is a significant milestone for Canada in the fight against the pandemic. We appreciate Health Canada's timely review," said Takashi Nagao, the company's president and CEO, in the statement.

"We're also grateful for the Government of Canada's support in the development of this new vaccine, and we are manufacturing doses to start fulfilling its order."

Given this huge influx of vaccines, Canada's deputy chief public health officer Dr. Howard Njoo said some of those expected Medicago supplies will be part of Canada's ongoing efforts to send doses abroad.

"Canada is committed to the global effort to supply vaccines across the world," he said during a press conference.

Recommendations on the vaccine's use from the National Advisory Committee on Immunization are also expected in the weeks ahead, Njoo said.

Vaccine not approved for adults over 65

For now, the vaccine is only authorized for use in adults 18 to 64 years of age, based on the data that was reviewed by Health Canada.

"There was limited enrolment of participants older than 65 years of age in the clinical trials because a large proportion of older individuals were

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already vaccinated," the department said in its statement. "Medicago is currently gathering data in older individuals to support regulatory authorization for this age group."

Dr. Isaac Bogoch, an infectious diseases specialist based in Toronto, told CBC News the vaccine's approval is good news, even though it comes after the majority of Canadians are already vaccinated with two or more doses.

"Is this going to have a major impact on us here in Canada? Probably not. But there might be some individuals who choose to get vaccinated with a non-mRNA product," he said, referring to the shots offered by Pfizer-BioNTech and Moderna.

What's most hopeful, Bogoch added, is how plant-based technology could help future vaccine development.,

The process developed by Medicago uses the plant species nicotiana benthamiana, a close relative of tobacco plants that is used for pharmaceutical development, largely because of the high number of viruses that can successfully infect it.

"This might be a pretty unique way to produce and scale vaccination," Bogoch said.

CBC News, 24 February 2022

https://cbc.ca

Smart coatings in the pipeline: Made from cheap chemicals, this polymer packs a punch

2022-03-15

An imaginative approach to polymer surface coating has produced a sustainable way to remove mercury from water—while providing a wide range of protection including for preventing metal corrosion and solvent damage of plastic PVC pipes.

The smart coating, made from low-cost chemicals from oil refining and other sources, also can prevent acid and water damage of concrete surfaces and be repaired in situ by a simple heating process, says Flinders University project leader Max Mann.

"Made easily from elemental sulfur and dicyclopentadiene (DCPD is a by-product of petroleum refining), this new coating is multi-functional which gives us wide scope to use it in a wide range of useful ways and for longer

Along with its protective powers against corrosion, solvent damage and acid and water damage, the research found the active coating can capture toxic metals such as mercury.

lasting industrial products and components," says Flinders University Ph.D. candidate Mr Mann, lead author of the cover article in this month's issue of Polymer Chemistry.

"This exciting new area of research extends fundamental chemistry to several practical applications."

"The method for making the coating is safer than methods previously used for related coatings. The team developed a lower temperature process that prevented runaway reactions," adds co-author University of Liverpool researcher Dr. Bowen Zhang.

Along with its protective powers against corrosion, solvent damage and acid and water damage, the research found the active coating can capture toxic metals such as mercury.

The coating is repairable and scratches and damage can be prepared by the simple application of heat, the Flinders-Liverpool team found.

This process is possible because of the coating's chemical structure which allows sulfur-sulfur bonds to be broken and re-formed.

Flinders University chemistry Professor Justin Chalker says the research is a significant step forward in multi-functional coatings.

"The unique chemical composition of the smart coating enables protection of substrates, active removal of toxic mercury species from water and oil, and is repairable which ensures its sustainability," says Matthew Flinders Professor Chalker, from the Institute of Nanoscale Science and Technology at Flinders University.

"The coating is solvent resistant and can also remove mercury from oil and water mixtures, which is of importance to remediation in the petroleum and gas industry."

Mr Mann conducted part of this study in the UK on an exchange at Dr. Tom Hasell's University of Liverpool lab as part of ongoing collaboration between the Chalker Lab and Hasell Lab in Liverpool.

Phys Org, 15 March 2022

https://phys.org

Measurements offer a new window into avian evolution and ecosystem health.

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First-of-its-kind global catalog of bird shapes yields ecological 'gold mine'

2022-03-16

In 2012, evolutionary biologist Catherine Sheard started an ambitious Ph.D. project: measuring the shape of every kind of passerine, or perching bird, in the world. "I thought, 'This is about 6000 species, that almost seems doable,'" Sheard says. It was, and her project catalyzed an international effort to measure all the world's birds.

Now, a team of 115 researchers from 30 countries, led by Sheard's Ph.D. adviser, Imperial College London ecologist Joseph Tobias, has published anatomical measurements of all 11,009 living bird species—not just passerines such as robins, but everything from ducks and penguins to vultures and ostriches. "It's a gold mine," says geneticist Nancy Chen of the University of Rochester, who was not involved in the project.

The open-source data set, called AVONET, debuts this month in a special issue of Ecology Letters along with papers describing its value for studying bird evolution and ecology, as well as the impact of changes in climate and habitat on vulnerable species. "For the first time, we are gaining a global, quantitative perspective on bird biodiversity, which is really amazing," says ecologist Brian Enquist of the University of Arizona.

Tobias drew inspiration from a massive database of plant measurements called TRY, which contains millions of records on leaf shape, chemical composition, average blooming dates, and more. By correlating these records with other types of data such as remote sensing, plant ecologists have studied a wide array of issues, including how steeply plant diversity declines when habitats are fragmented. Yet TRY has details for fewer than half of the world's 391,000 plant species, limiting its ability to answer some questions.

Assembling a complete data set for birds began to seem feasible after Sheard completed her effort, carefully wielding calipers on sometimes-fragile specimens to measure about 80 birds per day at five major museums in the United Kingdom and the United States.

All told, authors contributed data from 78 collections and some field studies. On average, they measured eight to nine individuals for each species. To fill in the last few hundred missing species, Tobias networked and cold-called researchers all over the world. "By that stage it was a labor of love," he says.

The AVONET data set contains 11 morphological traits, such as beak shape and wing length, for 90,020 individual birds from 181 countries. "It's phenomenal what they've done," says Çağan Sekercioğlu, an ornithologist and conservation ecologist at the University of Utah, who created a data set of bird ecological traits, including diet and habitat.

Earlier, incomplete versions of AVONET have already yielded insights. Sheard reported in 2020 in Nature Communications that species' geographical distributions, documented by earlier studies, correlate with flight ability, as revealed by the ratio of hand to wing length. Compared with migratory birds in temperate regions, sedentary birds in the tropics have stubbier wings, poorer flight, and more restricted ranges. That link between wing anatomy and flying range could help researchers gauge species' vulnerability to harm from habitat destruction or climate change, as poorer fliers might not be able to disperse from inhospitable environments, Sekercioğlu says.

Papers in the special issue report new findings. One shows that the evolution of flight reduced birds' reliance on weapons, such as bony spurs, likely because these defenses add extra weight. Another confirms that communities of bird species with more diversity of shapes, such as beaks specialized for niche diets, tend to have lower risks of extinction.

Other teams can apply the data to new questions. "This is really democratizing the data housed in museums," says Sahas Barve, a postdoc at the Smithsonian National Museum of Natural History. "Not only is it available for students everywhere, but it's available to scientists in the countries from where these specimens were originally taken."

Future studies can combine body shape measurements with genetic data, geographical distributions, and environmental conditions to test theories about birds' evolution and their role in ecosystems, says AVONET co-author Carsten Rahbek of the University of Copenhagen. For example, AVONET measurements can help estimate the maximum size fruit a species can eat and roughly how far it might travel before defecating the seeds—clues to which plants it might spread, and how efficiently.

Researchers could then use the data set to predict the ecological consequences of global changes, such as deforestation and warming. "This is the door to the future," Rahbek says. For example, using data on species with beaks specialized for unusual flowers, researchers could predict which plant species are at higher risk of extinction if their avian pollinators vanish. In some tropical countries, large fruit-eating birds are hunted intensely, and their loss could reduce seed dispersal. Around the world, conservation decisions "are going to have to come fast and furious," Enquist says. "Data sets like this are enabling us to anticipate what will happen and helping inform what to do."

Tobias and others plan to continue improving the data set by filling in missing data for roughly 100 species. They will also measure more individuals and add other kinds of information about life history and behaviors. For now, the data set exists as a spreadsheet in a supplemental file to a paper. Creating a community-driven database and website like TRY would require new funding, as well as mechanisms to validate newly uploaded data, such as measurements taken when researchers or volunteers capture and band living birds. "If you put it all together," Tobias says, "you could get an amazing resource.

Science, 16 March 2022

https://science.org

Largest ever psychedelics study maps changes of conscious awareness to neurotransmitter systems

2022-03-16

Psychedelics are now a rapidly growing area of neuroscience and clinical research, one that may produce much-needed new therapies for disorders such as depression and schizophrenia. Yet there is still a lot to know about how these drug agents alter states of consciousness.

In the world's largest study on psychedelics and the brain, a team of researchers from The Neuro (Montreal Neurological Institute-Hospital) and Department of Biomedical Engineering of McGill University, the Broad Institute at Harvard/MIT, SUNY Downstate Health Sciences University, and Mila -- Quebec Artificial Intelligence Institute have shown how drug-induced changes in subjective awareness are anatomically rooted in specific neurotransmitter receptor systems.

The researchers gathered 6,850 testimonials from people who took a range of 27 different psychedelic drugs. In a first-of-its-kind approach, they designed a machine learning strategy to extract commonly used words from the testimonials and link them with the neurotransmitter receptors that likely induced them. The interdisciplinary team could then associate the subjective experiences with brain regions where the receptor combinations are most commonly found -- these turned out to be the lowest and some of the deepest layers of the brain's information processing layers.

"Hallucinogenic drugs may very well turn out to be the next big thing to improve clinical care of major mental health conditions".

Using thousands of gene transcription probes, the team created a 3D map of the brain receptors and the subjective experiences linked to them, across the whole brain. While psychedelic experience is known to vary widely from person to person, the large testimonial dataset allowed the team to characterize coherent states of conscious experiences with receptors and brain regions across individuals. This supports the theory that new hallucinogenic drug compounds can be designed to reliably create desired mental states.

For example, a promising effect of some psychedelics for psychiatric intervention is ego-dissolution -- the feeling of being detached with the self. The study found that this feeling was most associated with the receptor serotonin 5-HT2A. However, other serotonin receptors (5-HT2C, 5-HT1A, 5-HT2B), adrenergic receptors Alpha-2A and Beta-2, as well as the D2 receptor were also linked with the feeling of ego-dissolution. A drug targeting these receptors may be able to reliably create this feeling in patients whom clinicians believe might benefit from it.

"Hallucinogenic drugs may very well turn out to be the next big thing to improve clinical care of major mental health conditions," says Professor Danilo Bzdok, the study's lead author "Our study provides a first step, a proof of principle that we may be able to build machine learning systems in the future that can accurately predict which neurotransmitter receptor combinations need to be stimulated to induce a specific state of conscious experience in a given person."

This study, published in the journal Science Advances on March 16, 2022, was funded with the help of the Brain Canada Foundation, through the Canada Brain Research Fund, as well as by NIH grant R01AG068563A and the Canadian Institutes of Health Research. Danilo Bzdok was also supported by the Healthy Brains Healthy Lives initiative (Canada First Research Excellence fund), and by the CIFAR Artificial Intelligence Chairs program (Canada Institute for Advanced Research), as well as Google.

Science Daily, 16 March 2022

https://sciencedaily.com

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Why do people get their best ideas in the shower?

2022-03-14

When it comes to taking daily showers, there are generally two types of people - those who see jumping under the jets as a functional job to tick off in the morning, and those who savour being in the warm water and extend it for an extra five minutes or so.

Whichever camp you fall into, the benefits of taking a shower might be more than skin deep - and there's a reason why many people get their best ideas when they're daydreaming under the water.

A study by cognitive psychologist Scott Barry Kaufman found that 72% of people generate new ideas while they're in the shower - giving themselves permission to daydream, which can be an important element to incubating creative thoughts.

The survey, which looked at 4,000 people aged 18 to 64 across eight different countries and was commissioned in 2014, revealed that 14% of people take showers for the specific purpose of dreaming up a new idea, for fresh thinking or for problem-solving.

Speaking at an Ignite80 (ignite80.com) panel, Kauffman said the "relaxing, solitary, and non-judgmental shower environment" may help people to think more creatively, as it allows "the mind to wander freely, causing people to be more open to their inner stream of consciousness and daydreams".

Nikki Taylor is a busy entrepreneur who has tapped into the benefits of so-called 'power showering', using Kauffman's idea of creative brainstorming to help generate new ideas. "Before I became a mum, I used to love journaling," says Taylor, who runs a property consulting business (italy-propertyconsulting.com).

"The only time I really have to myself is when I'm in the shower, so I utilise that five to 10 minutes to think about what I'm grateful for and to visualise what I want from my business in the future."

Taylor says that when we journal, we tend to just head into auto-pilot and write down the same thoughts and feelings. By contrast: "When you're thinking of ideas in the moment, especially in the shower, it's a great way to daydream and manifest some bigger-picture ideas that you might not normally have time to think about."

The benefits of taking a shower might be more than skin deep - and there's a reason why many people get their best ideas when they're daydreaming under the water.

So how do you get in on the entrepreneurial power shower game? "Some people might want to record their ideas and thinking processes using their smartphone while they're in the shower, so you can listen back to it later," she suggests.

Taylor says she prefers to start with affirmations - positive statements that can help you to challenge and overcome self-sabotaging and negative thoughts. "I say them out loud to myself in the shower, and then I'll think about any problems I'm encountering in my business.

"Being in the shower forces you to be away from your phone and your laptop, and I can't think of any other time where you can creatively think without any interruptions.

"I think it's a really handy tip for anyone who's time-poor like me," she says, adding: "We get so caught up in life that journaling can become a bit of a chore. You always have that time in the shower that's yours - away from emails, social media and other distractions."

The Brighter Side of News, 14 March 2022

https://thebrighterside.news

Two computer scientists explain how the Internet of Things can violate your privacy

2022-03-14

Have you ever felt a creeping sensation that someone's watching you? Then you turn around and you don't see anything out of the ordinary. Depending on where you were, though, you might not have been completely imagining it. There are billions of things sensing you every day. They are everywhere, hidden in plain sight—inside your TV, fridge, car and office. These things know more about you than you might imagine, and many of them communicate that information over the internet.

Back in 2007, it would have been hard to imagine the revolution of useful apps and services that smartphones ushered in. But they came with a cost in terms of intrusiveness and loss of privacy. As computer scientists who study data management and privacy, we find that with internet connectivity extended to devices in homes, offices and cities, privacy is in more danger than ever.

Internet of Things

Smart devices collect a wide range of data about their users.

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Your appliances, car and home are designed to make your life easier and automate tasks you perform daily: switch lights on and off when you enter and exit a room, remind you that your tomatoes are about to go bad, personalize the temperature of the house depending on the weather and preferences of each person in the household.

To do their magic, they need the internet to reach out for help and correlate data. Without internet access, your smart thermostat can collect data about you, but it doesn't know what the weather forecast is, and it isn't powerful enough to process all of the information to decide what to do.

But it's not just the things in your home that are communicating over the internet. Workplaces, malls and cities are also becoming smarter, and the smart devices in those places have similar requirements. In fact, the Internet of Things (IoT) is already widely used in transport and logistics, agriculture and farming, and industry automation. There were around 22 billion internet-connected devices in use around the world in 2018, and the number is projected to grow to over 50 billion by 2030.

What these things know about you

Smart devices collect a wide range of data about their users. Smart security cameras and smart assistants are, in the end, cameras and microphones in your home that collect video and audio information about your presence and activities. On the less obvious end of the spectrum, things like smart TVs use cameras and microphones to spy on users, smart lightbulbs track your sleep and heart rate, and smart vacuum cleaners recognize objects in your home and map every inch of it.

Sometimes, this surveillance is marketed as a feature. For example, some Wi-Fi routers can collect information about users' whereabouts in the home and even coordinate with other smart devices to sense motion.

Manufacturers typically promise that only automated decision-making systems and not humans see your data. But this isn't always the case. For example, Amazon workers listen to some conversations with Alexa, transcribe them and annotate them, before feeding them into automated decision-making systems.

But even limiting access to personal data to automated decision making systems can have unwanted consequences. Any private data that is shared over the internet could be vulnerable to hackers anywhere in the world, and few consumer internet-connected devices are very secure.

Understand your vulnerabilities

With some devices, like smart speakers or cameras, users can occasionally turn them off for privacy. However, even when this is an option, disconnecting the devices from the internet can severely limit their usefulness. You also don't have that option when you're in workspaces, malls or smart cities, so you could be vulnerable even if you don't own smart devices.

Therefore, as a user, it is important to make an informed decision by understanding the trade-offs between privacy and comfort when buying, installing and using an internet-connected device. This is not always easy. Studies have shown that, for example, owners of smart home personal assistants have an incomplete understanding of what data the devices collect, where the data is stored and who can access it.

Governments all over the world have introduced laws to protect privacy and give people more control over their data. Some examples are the European General Data Protection Regulation (GDPR) and California Consumer Privacy Act (CCPA). Thanks to this, for instance, you can submit a Data Subject Access Request (DSAR) to the organization that collects your data from an internet-connected device. The organizations are required to respond to requests within those jurisdictions within a month explaining what data is collected, how it is used within the organization and whether it is shared with any third parties.

Limit the privacy damage

Regulations are an important step; however, their enforcement is likely to take a while to catch up with the ever-increasing population of internet-connected devices. In the meantime, there are things you can do to take advantage of some of the benefits of internet-connected without giving away an inordinate amount of personal data.

If you own a smart device, you can take steps to secure it and minimize risks to your privacy. The Federal Trade Commission offers suggestions on how to secure your internet-connected devices. Two key steps are updating the device's firmware regularly and going through its settings and disabling any data collection that is not related to what you want the device to do. The Online Trust Alliance provides additional tips and a checklist for consumers to ensure safe and private use of consumer internet-connected devices.

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If you are on the fence about purchasing an internet-connected device, find out what data it captures and what the manufacturer's data management policies are from independent sources such as Mozilla's Privacy Not Included. By using this information, you can opt for a version of the smart device you want from a manufacturer that takes the privacy of its users seriously.

Last but not least, you can pause and reflect on whether you really need all your devices to be smart. For example, are you willing to give away information about yourself to be able to verbally command your coffee machine to make you a coffee?

Tech Xplore, 14 March 2022

https://techxplore.com

Our universe may have a twin that runs backward in time

2022-03-16

A wild new theory suggests there may be another "anti-universe," running backward in time prior to the Big Bang.

An anti-universe running backwards in time could explain dark matter and cosmic inflation

The idea assumes that the early universe was small, hot and dense — and so uniform that time looks symmetric going backward and forward.

If true, the new theory means that dark matter isn't so mysterious; it's just a new flavor of a ghostly particle called a neutrino that can only exist in this kind of universe. And the theory implies there would be no need for a period of "inflation" that rapidly expanded the size of the young cosmos soon after the Big Bang.

If true, then future experiments to hunt for gravitational waves, or to pin down the mass of neutrinos, could answer once and for all whether this mirror anti-universe exists.

Preserving symmetry

Physicists have identified a set of fundamental symmetries in nature. The three most important symmetries are: charge (if you flip the charges of all the particles involved in an interaction to their opposite charge, you'll get the same interaction); parity (if you look at the mirror image of an interaction, you get the same result); and time (if you run an interaction backward in time, it looks the same).

Physical interactions obey most of these symmetries most of the time, which means that there are sometimes violations. But physicists have never observed a violation of a combination of all three symmetries at the same time. If you take every single interaction observed in nature and flip the charges, take the mirror image, and run it backward in time, those interactions behave exactly the same.

This fundamental symmetry is given a name: CPT symmetry, for charge (C), parity (P) and time (T).

In a new paper recently accepted for publication in the journal Annals of Physics, scientists propose extending this combined symmetry. Usually this symmetry only applies to interactions — the forces and fields that make up the physics of the cosmos. But perhaps, if this is such an incredibly important symmetry, it applies to the whole entire universe itself. In other words, this idea extends this symmetry from applying to just the "actors" of the universe (forces and fields) to the "stage" itself, the entire physical object of the universe.

Creating dark matter

We live in an expanding universe. This universe is filled with lots of particles doing lots of interesting things, and the evolution of the universe moves forward in time. If we extend the concept of CPT symmetry to our entire cosmos, then our view of the universe can't be the entire picture.

Instead, there must be more. To preserve the CPT symmetry throughout the cosmos, there must be a mirror-image cosmos that balances out our own. This cosmos would have all opposite charges than we have, be flipped in the mirror, and run backward in time. Our universe is just one of a twin. Taken together, the two universes obey CPT symmetry.

The study researchers next asked what the consequences of such a universe would be.

They found many wonderful things.

For one, a CPT-respecting universe naturally expands and fills itself with particles, without the need for a long-theorized period of rapid expansion known as inflation. While there's a lot of evidence that an event like inflation occurred, the theoretical picture of that event is incredibly fuzzy. It's so fuzzy that there is plenty of room for proposals of viable alternatives.

Second, a CPT-respecting universe would add some additional neutrinos to the mix. There are three known neutrino flavors: the electron-neutrino, muon-neutrino and tau-neutrino. Strangely, all three of these neutrino flavors are left-handed (referring to the direction of its spin relative to its motion). All other particles known to physics have both left- and right-handed varieties, so physicists have long wondered if there are additional right-handed neutrinos.

A CPT-respecting universe would demand the existence of at least one right-handed neutrino species. This species would be largely invisible to physics experiments, only ever influencing the rest of the universe through gravity.

But an invisible particle that floods the universe and only interacts via gravity sounds a lot like dark matter.

The researchers found that the conditions imposed by obeying CPT symmetry would fill our universe with right-handed neutrinos, enough to account for the dark matter.

Predictions in the mirror

We would never have access to our twin, the CPT-mirror universe, because it exists "behind" our Big Bang, before the beginning of our cosmos. But that doesn't mean we can't test this idea.

The researchers found a few observational consequences of this idea. For one, they predict that the three known left-handed neutrino species should all be Majorana particles, which means that they are their own antiparticles (in contrast to normal particles like the electron, which have antimatter counterparts called the positrons). As of now, physicists aren't sure if neutrinos have this property or not.

Additionally, they predict that one of the neutrino species should be massless. Currently, physicists can only place upper limits on the neutrino masses. If physicists can ever conclusively measure the neutrino masses, and one of them is indeed massless, that would greatly bolster the idea of a CPT-symmetric universe.

Lastly, in this model the event of inflation never occurred. Instead, the universe filled with particles naturally on its own. Physicists believe that inflation shook space-time to such a tremendous degree that it flooded the cosmos with gravitational waves. Many experiments are on the hunt for these primordial gravitational waves. But in a CPT-symmetric universe, no such waves should exist. So if those searches for primordial

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gravitational waves turn up empty, that might be a clue that this CPT-mirror universe model is correct.

Live Science, 16 March 2022

https://livescience.com

How hydropower dams impact the communities they're built in

2022-03-15

Over the last two decades, almost 1,000 hydropower dams have been built around the globe. And while these dams provide many benefits to farmers, wildlife and the climate, the costs of their construction on local communities where they are built has largely been left out of the conversation—that is, until now.

Led by Dr. Peilei Fan, a team of six Michigan State University social scientists—including doctoral student Myung Sik Cho, Drs. Zihan Lin, Jiaguo Qi, Jiquan Chen and Emilio Moran—and Stanford University researcher Dr. Zutao Ouyang found that despite the overall positive impact that hydropower dams have on the globe and countries as a whole, communities in the immediate areas surrounding dams often experience worse economic conditions, population relocation and/or a loss of green spaces due their construction.

For this research, the team analyzed 631 hydropower dams, all built since 2001 and commissioned before 2015, across five regions: Africa, Asia, Europe, North America and South America. The study, published in the Proceedings of the National Academy of Sciences (PNAS), highlights a need to address these disparities to reduce harm to local communities in the surrounding areas.

Dr. Fan was inspired to lead this research after visiting two separate areas where dams were recently constructed, and seeing the sudden change that was inflicted on surrounding local people. One was a 2015 visit to Tonle Sap Lake in Cambodia, and the other was a 2018 visit to the Mekong River Basin in Laos.

"The residents, relocated several years ago, seemed to have a better life than before, but they were still anxious and uncertain about their future," Fan reflected. "Talking to the people whose lives have been changed because of the dam construction made me realize that most existing evaluations are mostly case studies on large dams, and there lacks a

Communities in the immediate areas surrounding dams often experience worse economic conditions, population relocation and/or a loss of green spaces due their construction.

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comprehensive analysis at a global scale, including small- and medium-sized dams."

Hydropower dams pose numerous potential benefits, such as helping to reduce the impact of flooding and droughts, providing water to farmlands, allowing for easier transportation and providing energy production. However, these benefits are accompanied by negative consequences such as the displacement of local populations and damage to surrounding ecosystems.

For example, the study shows that the construction of hydroelectric dams was associated with less economic development or decreased population in nearby areas (within 50 kilometers of the dam) in the Global South (including Africa, Asia and South America). Additionally, the construction often destroys local greenspaces within 50 kilometers of the dam, either as the result of deforestation for the sake of the dam's construction or for the creation of agricultural land that can be irrigated by the dam after it is built.

For Fan, these findings highlight a need for further research and policy recommendations to protect local communities from harm—especially relocation.

"In general, a humane approach towards assisting relocated populations is needed," Dr. Fan explained. "This can be improving the capacity of local communities to negotiate their benefits with the constructor of the dams; helping relocated residents integrate and assimilate into their new destination communities while maintaining their previous social network and support system; or creating new job opportunities to compensate for the loss of their lands and source of livelihood."

In the future, Dr. Fan hopes to expand on this research by exploring the political and economic forces driving the construction of hydroelectric dams, as well as alternative energy solutions that can produce similar benefits without the negative consequences associated with these dams.

"There is also a need to understand the political ecology of dam construction, the influence of global investors, and the combined impacts of dam construction, climate change and land transitions," said Dr. Fan. "I am also curious if there are alternative or better ways for energy

production, rather than hydropower, for different regions of the Global South."

Phys Org, 15 March 2022

https://phys.org

Novel theory of entropy may solve materials design issues

2022-03-16

A challenge in materials design is that in both natural and manmade materials, volume sometimes decreases, or increases, with increasing temperature. While there are mechanical explanations for this phenomenon for some specific materials, a general understanding of why this sometimes happens remains lacking.

However, a team of Penn State researchers has come up with a theory to explain and then predict it: Zentropy.

Zentropy is a play on entropy, a concept central to the second law of thermodynamics that expresses the measure of the disorder of a system that occurs over a period of time when there is no energy applied to keep order in the system. Think of a playroom in a preschool; if no energy is put into keeping it tidy, it quickly becomes disordered with toys all over the floor, a state of high entropy. If energy is put in via cleaning up and organizing the room once the children leave, then the room returns to a state of order and low entropy.

Zentropy theory notes that the thermodynamic relationship of thermal expansion, when the volume increases due to higher temperature, is equal to the negative derivative of entropy with respect to pressure, i.e., the entropy of most material systems decreases with an increase in pressure. This enables Zentropy theory to be able to predict the change of volume as a function of temperature at a multiscale level, meaning the different scales within a system. Every state of matter has its own entropy, and different parts of a system have their own entropy.

"When we talk about the configuration entropy (different ways particles rearrange within a system) that entropy is only part of the entropy of the system," said Zi-Kui Liu, Dorothy Pate Enright Professor of Materials Science and Engineering and primary investigator in the study. "So, you have to add the entropy of individual components of that system into the equation, and then you consider the different scales, the universe, the

Entropy is the measure of the disorder in a system that occurs over a period of time with no energy put into restoring the order. Zentropy integrates entropy at multiscale levels.

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Earth, the people, the materials; these are different scales within different systems."

The authors of the study, published in the Journal of Phase Equilibria and Diffusion, believe that Zentropy may be able to predict anomalies of other physical properties of phases beyond volume. This is because responses of a system to external stimuli are driven by entropy.

Macroscopic functionalities of materials stem from assemblies of microscopic states (microstates) at all scales at and below the scale of the macroscopic state of investigation. These functionalities are challenging to predict because only one or a few microstates can be considered in a typical computational approach such as the predictive "from the beginning" calculations, which help determine the fundamental properties of materials.

"This challenge becomes acute in materials with multiple phase transitions, which are processes that convert matter from one state to another, such as vaporization of a liquid," Liu said. "This is often where the most transformative functionalities exist, such as superconductivity and giant electromechanical response."

Zentropy theory "stacks" these different scales into an entropy theory that encompasses the different elements of an entire system, presenting a nested formula for the entropy of complex multiscale systems, according to Liu.

"You have these different scales and you can stack them up with Zentropy theory," Liu said. "For example, atoms as a vibrational property, that's low scale, then you have electronic interaction, that even lower scale. So now how do you stack them together to cover the entire system? So that is what the Zentropy equation is about, stacking them together. It creates a partition function that is the sum of all the entropy scales."

This approach has been something Liu's lab has worked on for more than 10 years and five different published studies.

"The idea actually became very simple after we studied it and understood it," Liu said.

Zentropy has potential to change the way materials are designed, especially those that are part of systems that are exposed to higher temperatures. These temperatures, given thermal expansion, could cause issues if the materials expand.

"This has the potential to enable the fundamental understanding and design of materials with emergent properties, such as new superconductors and new ferroelectric materials that could potentially lead to new classes of electronics," Liu said. "Also, other applications such as designing better structural materials that withstand higher temperatures are also possible."

While there are benefits for society in general, researchers could apply Zentropy to multiple fields. This is because of how entropy is present in all systems. "The Zentropy theory has the potential to be applied to larger systems because entropy drives changes in all systems whether they are black holes, planets, societies or forests," Liu said.

Along with Liu, other authors of the study include Yi Wang, research professor in materials science and engineering, and Shun-Li Zhang, research professor in materials science and engineering.

Phys Org, 16 March 2022

https://phys.org

Close the blinds during sleep to protect your health

2022-03-14

Close the blinds, draw the curtains and turn off all the lights before bed. Exposure to even moderate ambient lighting during nighttime sleep, compared to sleeping in a dimly lit room, harms your cardiovascular function during sleep and increases your insulin resistance the following morning, reports a new Northwestern Medicine study.

"The results from this study demonstrate that just a single night of exposure to moderate room lighting during sleep can impair glucose and cardiovascular regulation, which are risk factors for heart disease, diabetes and metabolic syndrome," said senior study author Dr. Phyllis Zee, chief of sleep medicine at Northwestern University Feinberg School of Medicine and a Northwestern Medicine physician. "It's important for people to avoid or minimize the amount of light exposure during sleep."

There is already evidence that light exposure during daytime increases heart rate via activation of the sympathetic nervous system, which kicks your heart into high gear and heightens alertness to meet the challenges of the day.

"Our results indicate that a similar effect is also present when exposure to light occurs during nighttime sleep," Zee said.

Even moderate light exposure during sleep harms heart health and increases insulin resistance

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The study was published March 14 in PNAS.

Heart rate increases in light room, and body can't rest properly

"We showed your heart rate increases when you sleep in a moderately lit room," said Dr. Daniela Grimaldi, a co-first author and research assistant professor of neurology at Northwestern. "Even though you are asleep, your autonomic nervous system is activated. That's bad. Usually, your heart rate together with other cardiovascular parameters are lower at night and higher during the day."

There are sympathetic and parasympathetic nervous systems to regulate our physiology during the day and night. Sympathetic takes charge during the day and parasympathetic is supposed to at night, when it conveys restoration to the entire body.

How nighttime light during sleep can lead to diabetes and obesity

Investigators found insulin resistance occurred the morning after people slept in a light room. Insulin resistance is when cells in your muscles, fat and liver don't respond well to insulin and can't use glucose from your blood for energy. To make up for it, your pancreas makes more insulin. Over time, your blood sugar goes up.

An earlier study published in JAMA Internal Medicine looked at a large population of healthy people who had exposure to light during sleep. They were more overweight and obese, Zee said.

"Now we are showing a mechanism that might be fundamental to explain why this happens," Zee said. "We show it's affecting your ability to regulate glucose."

The participants in the study weren't aware of the biological changes in their bodies at night.

"But the brain senses it," Grimaldi said. "It acts like the brain of somebody whose sleep is light and fragmented. The sleep physiology is not resting the way it's supposed to."

Exposure to artificial light at night during sleep is common

Exposure to artificial light at night during sleep is common, either from indoor light emitting devices or from sources outside the home, particularly in large urban areas. A significant proportion of individuals (up to 40%) sleep with a bedside lamp on or with a light on in the bedroom and/or keep the television on.

Light and its relationship to health is double edged.

"In addition to sleep, nutrition and exercise, light exposure during the daytime is an important factor for health, but during the night we show that even modest intensity of light can impair measures of heart and endocrine health," Zee said.

The study tested the effect of sleeping with 100 lux (moderate light) compared to 3 lux (dim light) in participants over a single night. The investigators discovered that moderate light exposure caused the body to go into a higher alert state. In this state, the heart rate increases as well as the force with which the heart contracts and the rate of how fast the blood is conducted to your blood vessels for oxygenated blood flow.

"These findings are important particularly for those living in modern societies where exposure to indoor and outdoor nighttime light is increasingly widespread," Zee said.

Zee's top tips for reducing light during sleep

(1) Don't turn lights on. If you need to have a light on (which older adults may want for safety), make it a dim light that is closer to the floor.

(2) Color is important. Amber or a red/orange light is less stimulating for the brain. Don't use white or blue light and keep it far away from the sleeping person.

(3) Blackout shades or eye masks are good if you can't control the outdoor light. Move your bed so the outdoor light isn't shining on your face.

Is my room too light?

"If you're able to see things really well, it's probably too light," Zee said.

Other Northwestern authors are co-first author said co-first author Ivy Mason, who at the time of the study was post-doctoral fellow at Northwestern and now is a research fellow at Harvard Medical School, Kathryn Reid, Chloe Warlick, Dr. Roneil Malkani and Dr. Sabra Abbott.

The research was supported, in part, by the National Center for Advancing Translational Sciences grant 8UL1TR000150-05, National Heart, Lung, and Blood Institute grant R01 HL140580, National Institute of Aging grant P01AG11412, all of the National Institutes of Health, and the American Heart Association.

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Inspired by the human ear, a new acoustic fabric converts audible sounds into electrical signals

2022-03-16

Having trouble hearing? Just turn up your shirt. That's the idea behind a new "acoustic fabric" developed by engineers at MIT and collaborators at Rhode Island School of Design.

The team has designed a fabric that works like a microphone, converting sound first into mechanical vibrations, then into electrical signals, similarly to how our ears hear.

All fabrics vibrate in response to audible sounds, though these vibrations are on the scale of nanometers—far too small to ordinarily be sensed. To capture these imperceptible signals, the researchers created a flexible fiber that, when woven into a fabric, bends with the fabric like seaweed on the ocean's surface.

The fiber is designed from a "piezoelectric" material that produces an electrical signal when bent or mechanically deformed, providing a means for the fabric to convert sound vibrations into electrical signals.

The fabric can capture sounds ranging in decibel from a quiet library to heavy road traffic, and determine the precise direction of sudden sounds like handclaps. When woven into a shirt's lining, the fabric can detect a wearer's subtle heartbeat features. The fibers can also be made to generate sound, such as a recording of spoken words, that another fabric can detect.

A study detailing the team's design appears in Nature. Lead author Wei Yan, who helped develop the fiber as an MIT postdoc, sees many uses for fabrics that hear.

"Wearing an acoustic garment, you might talk through it to answer phone calls and communicate with others," says Yan, who is now an assistant professor at the Nanyang Technological University in Singapore. "In addition, this fabric can imperceptibly interface with the human skin,

Having trouble hearing? Just turn up your shirt. That's the idea behind a new "acoustic fabric" developed by engineers at MIT and collaborators at Rhode Island School of Design.

enabling wearers to monitor their heart and respiratory condition in a comfortable, continuous, real-time, and long-term manner."

Yan's co-authors include Grace Noel, Gabriel Loke, Tural Khudiyev, Juliette Marion, Juliana Cherston, Atharva Sahasrabudhe, Joao Wilbert, Irmandy Wicaksono, and professors John Joannopoulos and Yoel Fink at MIT, along with collaborators from the Rhode Island School of Design (RISD), Lei Zhu from Case Western Reserve University, Chu Ma from the University of Wisconsin at Madison, and Reed Hoyt of the U.S. Army Research Institute of Environmental Medicine.

Sound layering

Fabrics are traditionally used to dampen or reduce sound; examples include soundproofing in concert halls and carpeting in our living spaces. But Fink and his team have worked for years to refashion fabric's conventional roles. They focus on extending properties in materials to make fabrics more functional. In looking for ways to make sound-sensing fabrics, the team took inspiration from the human ear.

Audible sound travels through air as slight pressure waves. When these waves reach our ear, an exquisitely sensitive and complex three-dimensional organ, the tympanic membrane, or eardrum, uses a circular layer of fibers to translate the pressure waves into mechanical vibrations. These vibrations travel through small bones into the inner ear, where the cochlea converts the waves into electrical signals that are sensed and processed by the brain.

Inspired by the human auditory system, the team sought to create a fabric "ear" that would be soft, durable, comfortable, and able to detect sound. Their research led to two important discoveries: Such a fabric would have to incorporate stiff, or "high-modulus," fibers to effectively convert sound waves into vibrations. And, the team would have to design a fiber that could bend with the fabric and produce an electrical output in the process.

With these guidelines in mind, the team developed a layered block of materials called a preform, made from a piezoelectric layer as well as ingredients to enhance the material's vibrations in response to sound waves. The resulting preform, about the size of a thick marker, was then heated and pulled like taffy into thin, 40-meter-long fibers.

Lightweight listening

The researchers tested the fiber's sensitivity to sound by attaching it to a suspended sheet of mylar. They used a laser to measure the vibration

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of the sheet—and by extension, the fiber—in response to sound played through a nearby speaker. The sound varied in decibel between a quiet library and heavy road traffic. In response, the fiber vibrated and generated an electric current proportional to the sound played.

"This shows that the performance of the fiber on the membrane is comparable to a handheld microphone," Noel says.

Next, the team wove the fiber with conventional yarns to produce panels of drapable, machine-washable fabric.

"It feels almost like a lightweight jacket—lighter than denim, but heavier than a dress shirt," says co-author Elizabeth Meiklejohn, an RISD graduate student who wove the fabric using a standard loom.

She sewed one panel to the back of a shirt, and the team tested the fabric's sensitivity to directional sound by clapping their hands while standing at various angles to the shirt.

"The fabric was able to detect the angle of the sound to within 1 degree at a distance of 3 meters away," Noel notes.

The researchers envision that a directional sound-sensing fabric could help those with hearing loss to tune in to a speaker amid noisy surroundings.

The team also stitched a single fiber to a shirt's inner lining, just over the chest region, and found it accurately detected the heartbeat of a healthy volunteer, along with subtle variations in the heart's S1 and S2, or "lub-dub" features. In addition to monitoring one's own heartbeat, Fink sees possibilities for incorporating the acoustic fabric into maternity wear to help monitor a baby's fetal heartbeat.

Finally, the researchers reversed the fiber's function to serve not as a sound-detector but as a speaker. They recorded a string of spoken words and fed the recording to the fiber in the form of an applied voltage. The fiber converted the electrical signals to audible vibrations, which a second fiber was able to detect.

In addition to wearable hearing aids, clothes that communicate, and garments that track vital signs, the team sees applications beyond clothing.

"It can be integrated with spacecraft skin to listen to (accumulating) space dust, or embedded into buildings to detect cracks or strains," Yan proposes. "It can even be woven into a smart net to monitor fish in the ocean. The fiber is opening widespread opportunities."

"The learnings of this research offers quite literally a new way for fabrics to listen to our body and to the surrounding environment," Fink says. "The dedication of our students, postdocs and staff to advancing research which has always marveled me is especially relevant to this work, which was carried out during the pandemic."

Tech Xplore, 16 March 2022

https://techxplore.com

Is there such a thing as the perfect alarm tone?

2022-03-18

With the return to office work – and no longer being able to roll out of bed and straight into a Zoom meeting – many of us will be waking up earlier to beat the morning rush. So it's important to ensure we're on top of our alarm game.

But what type of alarm provides peak alertness upon waking? Pythagoras posited this same question in around 500 BCE. He believed specific songs – melodies that roused the energies – had the ability to counteract the drowsiness waking may bring.

And he appears to have had a point. Research has now shown certain alarm sounds can indeed enhance our alertness upon waking.

In particular, alarms that have the qualities of "tunefulness" (think ABC by The Jackson 5) have melodies that energise the listener, and are great for effective waking.

But to understand why this is the case, we first need to understand how our brains respond to complex stimuli when moving out of the sleep state.

Waking up right is important

Waking up groggy never feels right. And how we wake up can not only affect our mood and the day's outlook, but also our cognition and mental performance.

In some instances, grogginess after waking has the potential to be dangerous several hours later, by reducing our performance in critical decision-making (such as in health settings, emergency responses, security or while driving).

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This cognitive state of reduced alertness is referred to as "sleep inertia". It's a growing concern as it can have serious consequences while performing high-risk tasks, including driving.

How does the brain wake up?

Transitioning from sleep to alertness does not follow an on/off switch-like system, as brain imaging techniques have revealed.

Waking relies on complex biological processes, including increased blood flow allocation to the brain. Studies show the brain regions important for alert performance (the prefrontal cortical regions) take longer to "start-up" than other areas (such as the basal ganglia) which are important for arousal. This means you can be awake, but not quite with it.

Research has also shown blood flow activity within the brain to be diminished after waking, in comparison to the pre-sleep state. Thus, alert wakefulness may in part require mechanisms that encourage a redistribution of blood flow to the brain – something certain types of sound and music can do.

Another factor that influences alertness upon waking is the stage of sleep at the time. You're less likely to feel groggy if you wake up from a light sleep, compared to a deeper slow-wave or REM sleep.

A light sleep stage is characterised by Theta wave frequencies (as measured from the brain's electrical activity) and can be associated with feeling drowsy. In this sleep stage, arousal from external stimuli such as an alarm can quickly draw a person out of sleep.

Conversely, deep sleep or slow-wave sleep consists of Delta wave frequencies, which are associated with unconsciousness. This is the more challenging sleep stage to fully wake up from.

Alarm effectiveness also depends on age. Young adults aged 18 to 25 need louder alarms than older people, and preteens need an even greater threshold than young adults. You may require an alarm as much as 20 decibels louder at 18 than you would at 80.

Is sound frequency and tune important?

But when it comes to choosing an alarm, what exactly is the best choice? A growing body of evidence suggests different alarm sounds can positively influence human performance after waking.

Our systematic review published in 2020 showed temporal frequencies (the pitch of the sound as measured in Hertz) around 500 Hz are better at arousing young children than 2000+ Hz varieties.

We lack research to say whether this also applies to adults, but it's assumed the same alarm types would be beneficial.

Voice notifications such as a person yelling "wake up!" work better than higher frequencies. However, they are not as effective as 500 Hz tonal beeping alarms – similar to those preinstalled in most mobile phones.

Our research also explores how qualities of music, and specifically melody, play a role in encouraging alert wakefulness. We found that the way in which people interpret their alarms "tunefulness" also reflects how groggy they feel after waking.

Here, people who use alarms that carry a tune they will readily hum along to will experience less grogginess than those with a standard "beeping" alarm.

With this in mind, we developed a custom rhythmic melody that led to significantly better performance upon and after waking, when compared to standard beeping alarms.

Other studies have also found popular music (which can be interpreted as being melodic) is good to counteract sleep inertia after a short nap, and even more yet if it is music the listener personally enjoys.

What can I do to improve my waking alarm?

What does all this mean for the day-to-day? Well, given all of the above, we believe the perfect alarm must sound something like this:

- it has a a melody you can easily sing or hum along to
- it has a dominant frequency around 500 Hz, or in the key of C5 and
- it is not too fast or too slow (100 – 120 beats per minute is ideal).

Also remember the alarm must be louder for younger people (or for particularly deep sleepers).

If we consider the default alarms available on our devices, much more work is needed – especially since research in this area is relatively new. Hence, we suspect the availability of custom alarm downloads will increase with time.

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Most pre-loaded alarms at the appropriate loudness will wake you, but specific designs (such as the one above) have been modelled on the latest research to not only encourage arousal, but also provide increased alertness.

The Conversation, 18 March 2022

https://theconversation.com

How Your Caffeine Addiction Is Hurting Marine Life

2022-03-16

Whether sipping a cappuccino or tossing back an energy drink, people turn to caffeine as the world's most popular stimulant.

What these devotees may not appreciate is that caffeine passed through the human body and flushed down the toilet is making its way through wastewater treatment plants and into the ocean—with potentially troubling results.

"Exposing marine organisms to caffeine raises very significant concerns," says Luís Vieira, lead author of a new study that summarizes global research on caffeine in marine waters.

Vieira conducted the study as a caffeine-craving ecotoxicologist at the University of Aveiro in Portugal. "I'm guilty: two to three coffees per day," he says. "No Red Bull."

Marine pollution is a widely studied field, which includes investigating the impact of pharmaceuticals and plastics. Caffeine, a natural psychoactive substance that affects mental function, has received relatively little attention, yet can affect marine life in several ways. Caffeine has been found in a wide range of wild fish, from the common silver-biddy of Saudi Arabia's Red Sea to South Africa's striped bonito.

In lab studies, researchers have exposed marine life such as algae, clams, mussels, worms, urchins, and small crustaceans to caffeine levels consistent with those recorded in the ocean. Their experiments showed negative impacts related to reproduction and development, growth, metabolic activity, and cellular damage.

Additional research is needed to see if the lab results are repeated in the ocean, Vieira says, and to determine how caffeine may react with other pollutants.

Lab trials show caffeine has a range of negative effects on marine species.

An estimated average of five percent of caffeine consumed by humans is excreted, the study says. Caffeine is not as persistent in the environment as other pollutants such as dioxins and PCBs, but it has a reported half-life in ocean water of 100 to 240 days.

"Because we're constantly releasing or excreting it, aquatic species in the receiving environment are exposed in perpetuity," says Peter Ross, a water pollution researcher with the Raincoast Conservation Foundation in British Columbia.

Caffeine levels are expected to be higher in estuaries as well as in urban and heavily touristed areas. Coastal marine zones that are shallow or feature poor tidal flushing are also at greater risk.

The higher the level of waste treatment, the better the chance of removing caffeine. Realistically, that is society's best bet for reducing the amount entering our oceans.

No one dares challenge the public's insatiable thirst for caffeine.

"People love their coffee, tea, and caffeinated colas," says Ross, who did not participate in the study. "You'll run into a social backlash."

Hakai Magazine, 16 March 2022

https://hakaimagazine.com

Wearing shoes in the house is just plain gross. The verdict from scientists who study indoor contaminants

2022-03-16

You probably clean your shoes if you step in something muddy or disgusting (please pick up after your dog!). But when you get home, do you always de-shoe at the door?

Plenty of Australians don't. For many, what you drag in on the bottom of your shoes is the last thing on the mind as one gets home.

We are environmental chemists who have spent a decade examining the indoor environment and the contaminants people are exposed to in their own homes. Although our examination of the indoor environment, via our DustSafe program, is far from complete, on the question of whether to shoe or de-shoe in the home, the science leans toward the latter.

It is best to leave your filth outside the door.

People spend up to 90% of their time indoors, so the question of whether or not to wear shoes in the house is not a trivial one.

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What contaminants are in your home, and how did they get there?

People spend up to 90% of their time indoors, so the question of whether or not to wear shoes in the house is not a trivial one.

The policy focus is typically on the outdoor environment for soil, air quality and environmental public health risks. However, there is growing regulatory interest in the question of indoor air quality.

The matter building up inside your home includes not just dust and dirt from people and pets shedding hair and skin.

About a third of it is from outside, either blown in or tramped in on those offensive shoe bottoms.

Some of the microorganisms present on shoes and floors are drug-resistant pathogens, including hospital-associated infectious agents (germs) that are very difficult to treat.

Add in cancer-causing toxins from asphalt road residue and endocrine-disrupting lawn chemicals, and you might view the filth on your shoes in a new light.

A roll-call of indoor nasties

Our work has involved the measurement and assessment of exposure to a range of harmful substances found inside homes including:

- antibiotic-resistant genes (genes that make bacteria resistant to antibiotics)
- disinfectant chemicals in the home environment
- microplastics
- the perfluorinated chemicals (also known as PFAS or "forever chemicals" because of their tendency to remain in the body and not break down) used ubiquitously in a multitude of industrial, domestic and food packaging products
- radioactive elements.

A strong focus of our work has involved assessing levels of potentially toxic metals (such as arsenic, cadmium and lead) inside homes across 35 nations (including Australia).

These contaminants – and most importantly the dangerous neurotoxin lead – are odourless and colourless. So there is no way of knowing whether the dangers of lead exposure are only in your soils or your water pipes, or if they are also on your living room floor.

The science suggests a very strong connection between the lead inside your home and that in your yard soil.

The most likely reason for this connection is dirt blown in from your yard or trodden in on your shoes, and on the furry paws of your adorable pets.

This connection speaks to the priority of making sure matter from your outdoor environment stays exactly there (we have tips here).

A recent Wall Street Journal article argued shoes in the home aren't so bad. The author made the point that E. coli – dangerous bacteria that develop in the intestines of many mammals, including humans – is so widely distributed that it's pretty much everywhere. So it should be no surprise it can be swabbed on shoe bottoms (96% of shoe bottoms, as the article pointed out).

But let's be clear. Although it's nice to be scientific and stick with the term E. coli, this stuff is, put more simply, the bacteria associated with poo.

Whether it is ours or Fido's, it has the potential to make us very sick if we are exposed at high levels. And let's face it – it is just plain gross.

Why walk it around inside your house if you have a very simple alternative – to take your shoes off at the door?

On balance, shoeless wins

So are there disadvantages to having a shoe-free household?

Beyond the occasional stubbed toe, from an environmental health standpoint there aren't many downsides to having a shoe-free house. Leaving your shoes at the entry mat also leaves potentially harmful pathogens there as well.

We all know prevention is far better than treatment and taking shoes off at the door is a basic and easy prevention activity for many of us.

Need shoes for foot support? Easy – just have some "indoor shoes" that never get worn outside.

There remains the issue of the "sterile house syndrome," which refers to increased rates of allergies among children. Some argue it's related to overly sterile households.

Indeed, some dirt is probably beneficial as studies have indicated it helps develop your immune system and reduce allergy risk.

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But there are better and less gross ways to do that than walking around inside with your filthy shoes on. Get outside, go for a bushwalk, enjoy the great outdoors.

Just don't bring the muckier parts of it inside to build up and contaminate our homes.

The Conversation, 16 March 2022

https://theconversation.com

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Technical Notes

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